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Factors predicting outcome after whiplash injury in subjects pursuing litigation

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Abstract Records of 277 patients presenting for medicolegal reporting following isolated whiplash injury were studied retrospectively. A range of pre-accident, accident and response variables were recorded. Multivariate analysis was used to determine the main factors that predict physical and psychological

outcome after whiplash injury. The factors that showed significant association with poor outcome on both physical and psychological outcome scales were pre-injury back pain, high frequency of General Practitioner attendance, evidence of pre-injury depression or anxiety symptoms, front position in the vehicle and pain radiating away from the neck after injury. The strongest associations were with factors that are present before impact. In this selected cohort of patients, there is a physical and a psychological vulnerability that may explain the widely varied response to low violence indirect neck injury.

Keywords Whiplash · Medicolegal · Cervical spine · Outcome measure · Prognosis

Introduction

Cervical whiplash is a common injury following road traffic accidents with a variable prognosis that can be difficult to predict. Whiplash is seen more frequently in the medicolegal than the clinical environment and there is little clinical or radiological evidence of a pathological mechanism. These features raise the possibility that psychosocial factors may be as relevant as physical pathology in determining outcome.

Previous reports have associated a number of variables with poor outcome, including the physical and

psychological state of the patient before injury, the accident mechanism and awareness of impact, and the ensuing symptoms and signs (Table 1).

Many of these associations have been derived from limited studies that involved small cohorts, omitted interview and physical examination, did not use validated disability indices, have access to medical records or distinguish the effects of covariables.

The aim of this study was to identify factors associated with a poor outcome in a large cohort of patients, who had all been interviewed and examined for the purpose of medicolegal reporting.

Materials and methods

Reports of 277 patients with isolated whiplash injuries examined for medicolegal reporting were analysed. Subjects were excluded from the study if there was objective evidence of structural injury. The variables recorded are detailed in Table 1.

Most of the variables were recorded directly from the reports. 176 (64%) reports had full copies of general practitioner (GP) records, allowing a count of the number of visits to the GP over the 5 years preceding the accident. The remaining 101 had incomplete or partially illegible records, and were therefore excluded from this section of the analysis. The records were also used to determine whether or not patients had presented to the GP with a depressive or anxiety-related disorder prior to the accident.

The outcome following whiplash injury was assessed using three scoring systems:

The Neck Disability Index (NDI) [40] is a validated scoring system for physical outcome, derived from the Oswestry low back pain disability questionnaire [6]. It combines pain and disability in a self-administered ten-item questionnaire with a maximum score of 50. Results can be doubled to create a percentage (0% normal, 100% maximum disability in every category).

The Gargan and Bannister Grade (GBG) [10] is a simple, reproducible, validated [19] classification based on the severity of symptoms. To facilitate statistical analysis, the GBG was recorded numerically (1–4) rather than the original A–D.

The scaled version of the general health questionnaire (GHQ) [13] is a self-administered screening questionnaire designed for use in consulting situations to detect psychiatric disorder. It has four subscales that cover somatic symptoms, anxiety and insomnia, social dysfunction and severe depression. The clinician scores the

questionnaire to give a result between 0 (normal) and 28. A threshold score of 5/6 is 80% sensitive and 89% specific for a diagnosable psychiatric disorder [13].

Statistics

Statistical analysis was performed using SPSS 12.0, under the guidance of a medical statistician. Individual factor analysis was performed by analysis of variance (ANOVA) testing. To assess the association between non-parametric continuous variables, the correlation coefficient Spearman's rho was calculated. Each subset of variables (pre-accident, accident and response) was subjected to multivariate analysis using a multiple linear regression model to identify the variables that had the most significant effect on outcome. Statistical significance was assumed for $P < 0.05$.

Results

There were 97 males and 180 females, of mean age 39.9 years (range 15–81). The reports were completed between 9 months and 5 years after injury (average 21 months). There was no association between elapsed time and outcome.

The results of individual factor analysis (ANOVA testing) are shown in Table 2. Multivariate analysis determined the individual variables that most strongly predict a poor outcome (Table 3). Many of these were present before the accident. The factors that showed significant association with poor outcome on all three scales were pre-injury back pain, high frequency of GP attendance, evidence of pre-injury attendances to the GP for depressive or anxiety symptoms, front position in the

Table 1 Variables recorded from medicolegal reports

Variable	References
Pre-accident variables	
Gender	3, 4, 5, 15, 18, 20, 22, 25, 26, 31, 35, 38, 39
Age	3, 4, 5, 18, 20, 25, 26, 30, 31, 38, 39
Known cervical spondylosis	17, 21, 23, 26, 28, 31, 41
Previous whiplash injury	5, 14, 19, 31
Pre-existing neck pain	26
Pre-existing back pain	No references
Visits to GP in 5 years prior to accident	39
Record of depression/anxiety disorders	2, 7, 14, 20, 22, 28, 32, 39
Accident variables	
Direction of impact	4, 14, 15, 21, 24, 27, 31, 39
Awareness of impending impact	5, 31, 34
Position in vehicle	4, 25, 26
Response variables	
Early onset of symptoms (< 12 h)	3, 4, 18, 22, 26, 30, 31, 39
Pain distribution other than neck alone	3, 18, 21, 26, 30, 31, 37, 38, 41
Abnormal neurological signs	14, 15, 18, 21, 23, 30, 31, 41

Table 2 Individual factor analysis

Variable		No.	Outcome measure, and significance					
			NDI (%)		GBG (1–4)		GHQ (0–28)	
Gender	F	180	42.3	$P < 0.05$	3.2	$P < 0.05$	10.5	NS
	M	97	35.5		3.0		9.2	
Age	15–24	30	34.2	NS	3.0	NS	8.2	NS
	25–34	73	40.1		3.0		10.2	
	35–44	68	40.1		3.1		10.4	
	45–54	65	40.5		3.2		10.1	
	55–64	32	43.9		3.2		11.3	
	> 64	9	30.2		2.9		7.5	
Previous whiplash injury	Y	57	43.1	$P < 0.05$	3.4	$P < 0.05$	11.8	NS
	N	220	39.1		3.0		9.6	
Pre-existing neck pain	Y	98	44.2	$P < 0.05$	3.3	$P < 0.05$	11.3	NS
	N	179	37.5		3.1		9.3	
Pre-existing back pain	Y	94	46.7	$P < 0.01$	3.3	$P < 0.01$	12.3	$P < 0.01$
	N	183	36.4		3.0		8.8	
Known spondylosis	Y	51	44.6	NS	3.3	NS	9.8	NS
	N	103	42.3		3.2		10.8	
	N/A	123						
Frequency of GP attendance	N/A	N/A		$P < 0.05$		$P < 0.05$		$P < 0.05$
Known psychological disorder	Y	95	51.3	$P < 0.01$	3.5	$P < 0.01$	15.4	$P < 0.01$
	N	111	33.6		2.9		7.5	
	N/A	71						
Impact front/rear/side	F	56	41.5	NS	3.1	NS	12.8	$P < 0.05$
	R	165	38.4		3.1		9.5	
	S	56	42.8		3.2		9.4	
Awareness	Y	111	41.8	NS	3.1	NS	10.9	NS
	N	166	38.6		3.1		9.4	
Position front/back	F	261	40.5	$P < 0.05$	3.1	$P < 0.05$	10.3	$P < 0.05$
	B	16	30.1		2.8		5.9	
Early symptoms (< 12 h)	Y	242	40.8	$P < 0.05$	3.2	$P < 0.05$	10.1	NS
	N	35	33.9		2.9		9.1	
Abnormal neurology	Y	63	42.9	NS	3.3	$P < 0.05$	11.9	$P < 0.05$
	N	214	39.1		3.1		9.5	
Pain away from neck	Y	238	41.1	$P < 0.01$	3.2	$P < 0.05$	10.6	$P < 0.01$
	N	39	32.4		2.9		6.5	

vehicle and pain radiating away from the neck after injury.

Females visited the GP more frequently in the 5-years prior to injury (Females mean 8.3 ± 6.6 visits per annum,

Males mean 5.0 ± 3.8 visits per annum, $P < 0.05$). When stratified by gender and age group, the mean number of GP attendances prior to injury only differed from the UK population average for certain groups (males

Table 3 Significant factors on multivariate analysis

	NDI	GBG	GHQ
Pre-accident variables			
Gender	NS	NS	NS
Age	NS	NS	NS
Previous whiplash	NS	NS	NS
Pre-existing neck pain	NS	NS	NS
Pre-existing back pain	$P < 0.01$	$P < 0.05$	$P < 0.05$
Known spondylosis	NS	NS	NS
Known psychological / anxiety disorder	$P < 0.01$	$P < 0.01$	$P < 0.01$
Frequent GP attendance	$P < 0.05$	$P < 0.05$	$P < 0.05$
Accident variables			
Direction of impact	NS	NS	$P < 0.05$
Awareness of impending impact	NS	NS	NS
Front position in vehicle	$P < 0.05$	$P < 0.05$	$P < 0.05$
Response variables			
Early onset of symptoms	$P < 0.05$	$P < 0.05$	NS
Abnormal neurological findings	NS	$P < 0.05$	$P < 0.05$
Pain radiating away from the neck	$P < 0.01$	$P < 0.05$	$P < 0.01$

between 35 years and 44 years and the females between 35 years and 64 years old). These groups had more consultations than expected (Table 4) [33].

The mean pre-accident GP attendance figures mask a large variation. The number of visits by males in 5 years ranged from 3 to 74, and for females from 1 to 177. An increased number of GP attendances prior to injury correlates significantly with poor outcome on all three indices (NDI $r=0.39$, $P<0.01$, GHQ $r=0.29$, $P<0.01$, GBG $r=0.28$, $P<0.01$; see Table 5).

Females were more likely than males to have documented pre-accident psychological or anxiety complaints (Females 51%, Males 34%, $P<0.05$). On multivariate analysis, this was the factor most strongly predictive of poor outcome on all three scales. At the time of medico-legal reporting, 64% of females and 62% of males had abnormal GHQ scores suggestive of a diagnosable psychiatric disorder (≥ 6).

Discussion

Any study of subjects pursuing compensation will be heavily skewed towards more symptomatic patients. This patient population clearly differs from studies involving all patients involved in RTAs recruited from A&E departments [4, 5, 9, 11, 23, 25] or those patients reporting initial neck pain following injury [18, 20, 21, 22, 27, 30, 31, 32, 34]. Although by definition this is a selective population, it is this group that is encountered most commonly by clinicians and is the subject of many

other studies [3, 16, 26, 38, 39]. It has been termed an 'acceptable source' of subjects for study by the quebec task force [36]. However, factors that predict outcome in this group of patients cannot be assumed to predict outcome in a group selected in a different manner.

Females fared worse than males, in agreement with all previous studies [3, 4, 5, 18, 22, 25, 26, 31, 35, 38, 39] but one [15] and there was an excess of female subjects in this study group. The multivariate analysis indicates that other pre-injury factors may determine this association with gender. It may result from physical differences in spinal musculature or psychological predisposition, as reflected by higher GHQ scores and more frequent GP attendance in females for all consultations and for those with a psychological or anxiety cause.

There was a non-significant trend to worse outcome with advancing age [3, 4, 5, 18, 25, 26, 31, 38, 39] and pre-existing cervical spondylosis [17, 21, 23, 26, 31, 41] reflecting the majority of a conflicting literature.

The association between poor outcome and previous whiplash injury has been reported by Khan et al. [19] in a group of patients that overlaps with the group analysed for this study. Dolinis [5] reported the significance of previous neck injury.

Back pain following whiplash injury occurs in approximately one third of patients [10, 15, 18], but this differs little from matched controls [12]. The close association shown in this subject group between pre-injury back pain and both physical (NDI, GBG) and psychological (GHQ) outcome following a whiplash injury is a new observation, although one recent study [39] showed an association with a past history of musculoskeletal complaints. This and the weaker association with constitutional neck pain [26] may be explained either by a predisposition to musculoskeletal injury or different coping mechanisms for axial pain [3]. This latter concept is supported by both the increased frequency of attendance to the GP prior to the accident in those patients with poor outcome and the strong association with pre-existing psychological illness demonstrated in this study.

Farbman [7] first suggested this association, linking prolonged physical symptoms with emotional factors such as a nervous disposition. Mayou and Bryant [22] found an association between psychological disease before injury and poor psychological and social outcome, but no correlation with physical outcome. Kivioja et al. [20] and Richter et al. [32] demonstrated psychological vulnerability to chronic whiplash symptoms in small cohorts of patients suffering neck pain following RTA. No such association was found by Turner et al. [39] in a group of 33 patients presenting for psychiatric reporting following whiplash injury. Radanov et al. [29] found that psychosocial factors at the time of injury were not predictive of outcome, but did not examine the medical records before injury.

Table 4 Mean annual GP attendance (prior to accident) by age group compared to UK average [33]

Age group	Males		Females	
	UK average	Whiplash	UK average	Whiplash
15–24	3	2.7	6	4.0
25–34	3	4.5	6	7.3
35–44	3	5.2	6	9.8
45–54	5	5.1	5	8.4
55–64	5	4.9	5	15.5
65+	5	7.2	7	7.8

Table 5 Gargan and Bannister Grade (outcome) and pre-accident GP attendance ($P<0.01$)

GBG	No. of subjects	Mean annual GP visits \pm SD
A (1)	4	2.8 \pm 0.6
B (2)	35	4.9 \pm 3.6
C (3)	163	6.8 \pm 5.9
D (4)	75	9.0 \pm 6.7

The high number of subjects with abnormal GHQ scores at the time of reporting confirms the existence of a secondary psychological disorder following whiplash injury. Gargan et al. [9] showed that this did not remit within 2 years and Squires et al. [37] showed that this persisted after 15 years.

The lack of clear association between direction of impact and poor outcome is consistent with mixed observations in the literature [4, 14, 15, 21, 24, 27, 31, 39]. The significance of awareness of impact has only been supported by one study of 29 patients [34].

Front position in the vehicle was one of the principal individual variables associated with poor outcome in this study. This is consistent with other reports [4, 25, 26] and may be due partly to the fact that the majority of rear-seat passengers were not wearing seatbelts. Wearing a seatbelt increases the risk [1, 8, 24, 25] and severity [4] of whiplash injury. Legislation to enforce the wearing of rear seat belts in the UK was introduced in 1991, but compliance may be more variable than for front seat occupants.

Early onset of symptoms [3, 4, 18, 22, 26, 30, 31], radiating pain and numbness [3, 18, 21, 26, 30, 31, 37, 38, 41] and objective neurological signs at the time of examination [14, 18, 21, 23, 30, 31] are consistent with a poor prognosis in the overwhelming proportion of the literature examining these variables.

Conclusions

A number of variables influence the physical and psychological outcome following whiplash injury and there is considerable overlap between validated physical and psychological outcome measures. Many of the individual factors that are most strongly associated with poor outcome in this group of patients are present before impact. This physical and psychological vulnerability may explain some of the variation in response to low violence indirect neck injury.

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